REMARKS

This Amendment is filed in response to the Office Action mailed March 1, 2010. All objections and rejections are respectfully traversed.

Claims 1-16, 39-40, and 45-51 are in the case.

No new claims have been added.

Request for Interview

The undersigned attorney respectfully requests a telephonic interview with the Examiner after the Examiner has had an opportunity to consider this Amendment, but before the issuance of the next Office Action. Additionally, Examiner is encouraged to contact the undersigned attorney with any questions.

Rejections Under 35 U.S.C. §112

At paragraph 10 of the Office Action, claims 1-16, 39-40, 47-49, and 51 were rejected under 35 U.S.C. §112, paragraph 2.

At paragraph 11 of the Office Action, the Office states:

> Applicant fails to provide how the process of determining which method requires the fewest number of read operations. Without the process of actually first performing each parity calculation method (subtraction and recalculation), there is no way of determining which one requires the fewest reads. (emphasis added)

At paragraph 13 of the Office Action, the Office states:

> Without specific steps to achieve those results, one of ordinary skills can not make and/or use the invention, as claimed. Thus the claim is indefinite as it does not provide enough information to ascertain how the invention functions... (emphasis added)

At paragraph 15 of the Office Action, the Office states:

> Applicant failed to indicate what process is involved in the "implementing the selection" step to realize "substantially minimize the number of read blocks" or "substantially maximizing chain lengths of read blocks", without which one of skills cannot understand how the claimed invention

> operates/functions to achieve the desired goal…without further steps defining what is involved in the implementation step, one in the art could not possibly understand how the implementation is implemented to obtain the desired results. (emphasis added)

Enablement

Applicant respectfully contends that it appears the Office Action rejected the claims for not enabling one of ordinary skill in the art to practice the claimed invention. Applicant respectfully directs the Office to **MPEP §2164.08**:

> As concerns the breadth of a claim relevant to enablement, the **only relevant concern** should be whether the scope of enablement provided to one skilled in the art by the disclosure is commensurate with the scope of protection sought by the claims. (emphasis added)
>
> One **does not** look to the claims but to the specification to find out how to practice the claimed invention. (emphasis added)

As can be seen at least from **MPEP §2164.08**, one skilled in the art must look to the disclosure (e.g., the specification), rather than the claims, to determine how the claimed invention operates/functions. As can be seen, at least in part from the following excerpts from Applicant's Specification, one skilled in the art may find out how to practice the claimed invention commensurate with the scope of protection sought by all currently pending claims.

> In one embodiment the method includes the steps of generating block layout information by a file system layer of the storage operating system by identifying which storage blocks within the plurality of blocks shall be used by a write operation for storing data; the identified blocks preferably having a high degree of locality or even being contiguous on individual disks. The method also includes transferring the block layout information from the file system layer to a RAID layer of the storage operating system, and in response to the block layout information, the RAID layer controlling the execution of the write operation to substantially minimize cost of parity calculations. Cost of parity calculation can be substantially minimized, e.g., by minimizing the number of read operations performed or substantially maximizing chain lengths of blocks read for the parity calculation.

In one embodiment, the step of controlling the write operation to substantially minimize parity calculation cost includes the steps of examining the write operation; selecting whether to substantially minimize the number of read blocks or to substantially maximize chain lengths of read blocks; and implementing the selection responsive to the block layout information. If the selection constitutes substantially minimizing the number of read blocks, then the write controlling step further includes the steps of determining on a stripe-by-stripe basis whether to calculate parity based on the subtraction method or the recalculation method and then performing any appropriate read operations to support the method selected and calculate parity. The determination is made by examining which calculation method would require the fewest read operations. On the other hand, if the selection constitutes substantially maximizing chain lengths of read blocks, then the write controlling step further includes the steps of deciding which storage blocks to read to substantially maximize chain length while minimizing the number of storage blocks read to support either the subtraction method or the recalculation method, and then perform read operations on those blocks and calculate parity. (page 4, line 10 to page 5, line 15)

"Chain length" means the number of blocks contained in a chain. "Maximizing chain length" is a process of achieving the longest possible chain length on a disk, which is limited to the number of storage blocks on the disk, but may also be limited to a reasonable lesser number, e.g., in order to avoid undue latency in assembly of chains or executing the I/O or due to limitations on the availability of resources necessary to perform the I/O. Maximizing chain length can be performed for each disk separately or for all disks in combination over the entire array. (page 11, lines 7-16)

Implementing the Least Cost of Parity Calculation Method in this illustrative example entails performing a number of read operations to obtain the data and parity from the array required to support the calculation. The read operations can be performed according to any of a number of alternate methodologies. The implementation can be designed to use one or another of these methodologies, or the selection of which to use can be performed dynamically during execution of write operations.

A first methodology entails determining the fewest number of read operations on a per stripe basis required to effectuate the parity calculation, while still chaining together reads from the same storage device wherever possible in one method. In this case the array is examined to ascertain the number of storage blocks in each stripe that are to be written. In each stripe, if the number to be written exceeds half the total number of storage blocks, the recalculation method is selected for

use; if the number is under half, the subtraction method is selected. If exactly half, one or the other of the parity calculation methods can be selected in the implementation. In the example shown, the subtraction method is selected for rows 1 and 2, the recalculation method is selected for row 3, and the subtraction method for rows 4 through 6.

After making the selection, the parity calculation method chosen is implemented. In the illustrated example, the fewest number of read operations can be realized by reading the data and parity from the storage blocks as following:

Read 11, 21

Read 34

Read 41, 51, 61

Read 1P, 2P

Read 4P, 5P, 6P

Thus, for this example, eleven read operations composed of five chains can be used to efficiently obtain the data and parity from the array in order to calculate parity for the new write. Performing the read operations as shown minimizes processor and memory resource consumption.

A second methodology entails identifying which storage blocks to read to substantially maximize chain length while minimizing the number of blocks read and being able to calculate parity in all read stripes by either the subtraction method or the recalculation method. The parity calculation method (i.e., subtraction or recalculation) chosen are implemented so that the required read operations entail the longest chain lengths within the entire array without regard to the per stripe number of reads. In the illustrated example, the longest chain lengths for the read operations are achieved by the following read operations:

Read 11, 21, 31, 41, 51, 61

Read 32

Read 33

Read 1P, 2P, 3P, 4P, 5P, 6P

Thus, for this example, fourteen read operations composed of four chains having maximal average chain length can be used to efficiently obtain the data and parity from the array in order to calculate parity for the new write. Performing the read operations as shown minimizes the total overhead for disk access.

Preferred implementations of the invention use either or both of these two alternative methodologies to perform the read operations, selecting an

> approach that provides the least cost for parity calculation. For example, if a system is memory constrained, the first methodology can be selected to use the least amount of memory; if a system is disk bandwidth constrained, the second methodology can be selected to reduce bandwidth usage. Thus, the invention may be practiced to perform the read operations according to either the methodology of fewest reads or the methodology of longest chain length, whichever is determined to be suitable to the system configuration. (page 14, line 9 to page 16, line 16)

Unclaimed "Critical Limitation"

Additionally, the Office Action contends that Applicant is not claiming a "critical feature". Applicant respectfully directs the Office to **MPEP §2164.08**:

> In determining whether an unclaimed feature is critical, the entire disclosure must be considered. Features which are merely preferred are not to be considered critical.
>
> Therefore, an enablement rejection based on the grounds that a disclosed critical limitation is missing from a claim should be made *only* when the language of the specification makes it clear that the limitation is critical for the invention to function as intended. **Broad language** in the disclosure, including the abstract, omitting an allegedly critical feature, tends to rebut the argument of criticality. (emphasis added)

Notably, Applicant's Abstract omits the allegedly critical features of "all the necessary process steps required to implement the selection" as declared necessary in the Office Action. As a result, as can be seen at least from **MPEP §2164.08**, the absence of the allegedly critical feature from the Abstract rebuts the assertion that there are critical features which are not claimed.

Furthermore, Applicant respectfully directs the Office to Applicant's specification at page 14, lines 9-17:

> Implementing the Least Cost of Parity Calculation Method in this illustrative example entails performing a number of read operations to obtain the data and parity from the array required to support the calculation. The read operations can be performed according to any of a number of alternate methodologies. The implementation can be designed to use one or another of these methodologies, or the selection of which to

> use can be performed dynamically during execution of write operations. (emphasis added)

As is clear, at least in part from the above citation, the particular methodologies of implementing the least cost of parity calculation may vary, and are described in **broad language** in the disclosure (i.e., illustrative example, alternate methodologies, etc.). As such, as can be seen at least from **MPEP §2164.08**, this is yet another piece of evidence rebutting the Office's assertion that there are critical features which are not claimed.

Accordingly, at least in view of the above arguments, Applicant respectfully urges that claims 1-16, 39-40, 47-49, and 51 satisfy all requirements as set forth under 35 U.S.C. §112.

Allowable Subject Matter

At paragraphs 17-18 of the Office Action, claims 45, 46, and 50 are allowed, and claims 1-16, 39-40, 47-49, and 51 would be allowable if amended to overcome the above-referenced §112, second paragraph rejections.

Conclusion

All new claims and/or claim amendments are believed to be fully supported by Applicant's specification.

All independent claims are believed to be in condition for allowance.

All dependent claims are believed to be dependent from allowable independent claims, and therefore in condition for allowance.

Favorable action is respectfully solicited.

Please charge any additional fee occasioned by this paper to our Deposit Account No. 03-1237.

Respectfully submitted,

/Michael T. Abramson/

Michael T. Abramson
Reg. No. 60,320
CESARI AND MCKENNA, LLP
88 BLACK FALCON AVENUE
BOSTON, MA 02210
Telephone: (617) 951-2500
Facsimile: (617) 951-3927